NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
ESDS Software Reuse Working Group

A Study of Earth Science Software Reuse Enablement Systems

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Software reuse is the reapplication of a variety of kinds of knowledge about one system to another system in order to reduce the effort of developing and maintaining that system.

Reusable assets can be from any part of the software development life cycle including: source code, analysis and design specification, plans, data, documentation, expertise and experience, and any information used to create software and software documentation.

Expected Benefits of Reuse

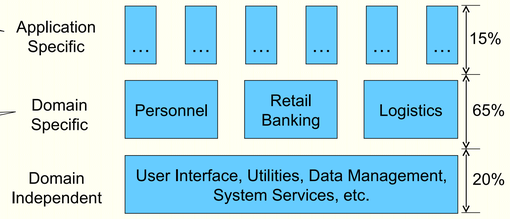
- Lower development costs
- Higher productivity; better use of resources
- Reduce cycle time; quicker development
- Lower training costs
- Easier maintenance
- Higher quality
- Lower risk
- Better interoperability

The 'application specific' layer represents software which is unique to a particular application. This is not software that can be reused.

The 'domain specific' layer represents software that is specific to a particular business area, e.g., Earth science missions. Software in this layer has the potential to be reused across similar types of systems.

Reuse in the 'domain independent' layer usually comes from commercial off-the-shelf (COTS) components and public open source software.

The composition of a 'typical' application…



… a theoretical reuse potential of up to 85% of new application development.

Source: Jeffery S. Poulin, "*Measuring Software Reuse*"

Background and Description of Existing Systems

In 2004, the Working Group collaborated for several months to select a set of important requirements needed for a system to meet the reuse needs of the Earth science software developer community.

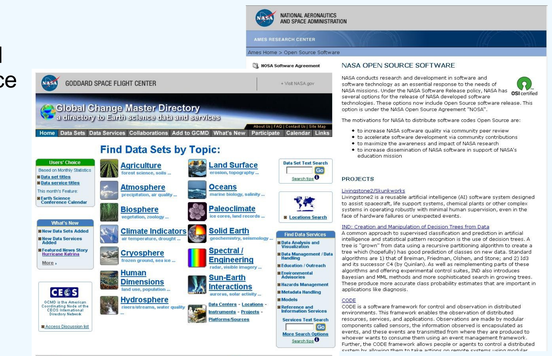
Types of requirements include:
- General
- Asset Usage
- Asset Submission
- Content Management
- System Administration

In 2005, the Working Group performed a trade study of seven NASA and ten non-NASA sites to determine how well existing systems, as-is, could meet these requirements. The domain of these sites varied (Earth science, engineering, general software, etc.) as did their target audiences and rules for inclusion of assets in the system.

Here, we consider the ability of the underlying software to fulfill some of our requirements from a user's perspective. Since the software used to design the systems varies, we focus on three main types:

- HTML
- Scripting languages (e.g., PHP)
- Repository in a Box (RIB)

NASA Open Source Sites – Good at promoting NASA-produced open source software



GCMD – Provides many data sets in many areas of Earth science

Sourceforge – A general software repository that provides software in many different fields

Reviews and Ratings

- Reviews refer to text comments/feedback written by users
- Ratings refer to a simple scoring mechanism, such as a 1-5 scale
- These are forms of peer-review that help other users determine which software assets are the most suitable for each job

Software	Meets Requirement?
HTML	✗ May be difficult to code effectively or not deemed important; also cannot be updated in real-time.
Scripting Language	½ Often simple reviews are provided, but no ratings, so this is partially met.
Repository in a Box	✗ Web pages RIB generates are simple and lack the front-end enhancements of some other systems; however, it may be possible to add these features.

Contributing and Updating Assets

- Allows users of the system to take a more active role in the reuse process by providing a method of distribution for their assets
- Updating features are necessary to provider users of the system with the most up-to-date assets, bug fixes, optimizations, etc.

Software	Meets Requirement?
HTML	✓ Most sites allow uploads and updates, but high or low functionality can be achieved with either HTML or scripting languages, so this is somewhat variable.
Scripting Language	
Repository in a Box	½ Sites we examined do not appear to allow general users to upload/update assets, but the system is capable of providing user accounts from which uploads are possible

Automatic Notifications

- Allows users to automatically receive notification of events such as addition of a new asset or new feedback
- E-mail is the most likely method of notification, but others such as RSS feed are possible

Software	Meets Requirement?
HTML	½ Static HTML cannot provide this feature, but server-side scripting could.
Scripting Language	✓ Details vary since this is normally implemented on a per-site basis.
Repository in a Box	✗ It may be possible to add this feature, but RIB is designed primarily for the back-end of the system.

Registering Asset Usage

- This is used to indicate *active* use of an asset
- Not the same thing as downloading an asset, which indicates a different level of usage
- Having a separate indication of active usage is helpful in measuring the actual level of reuse and generating metrics

Software	Meets Requirement?
HTML	✗ Static HTML alone cannot provide this feature because interaction with the user is not possible.
Scripting Language	✓ A web-based form captures the user's information and the scripting language processes it.
Repository in a Box	✗ This does not seem to be an inherent feature of RIB, but it may be possible to add.

Conclusions

- Existing systems provide valuable services for their target audiences
- Almost any of the software used in these systems could be reuse, with appropriate modifications, to develop a system for the Earth science software developer community

- Most systems are able to provide at least some functionality for most of our requirements, many of which are not included here
- Scripting languages are necessary to provide some features since static HTML cannot interact with users

- Repository in a Box (RIB) is a useful tool for creating web-based metadata repositories
- Uses Basic Interoperability Data Model (BIDM), IEEE Standard 1420.1, offering good control over how data are stored
- Focusing primarily on the back-end data storage, the web pages RIB creates are fairly basic
- It may be possible to modify RIB to provide more features and improve its front-end appearance

The Earth Science Data Systems Reuse Working Group has established a pilot reuse portal web site as the first step in creating a Reuse Enablement System (RES) for the Earth science community.

- Raise awareness of software reuse within the Earth science community
- Establish a platform for community members to share/exchange resources with each other
- Be the gateway for reuse information relevant to the community
- Make access to reuse resources easier
- Become the major starting site for reuse within the community

An architecture study is in progress to determine the best software to use in creating a new repository system.

http://softwarereuse.nasa.gov/